

PIC Simulation of Space-Charge-Dominated Sources*

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Abstract

For the highly space-charge-dominated beams found in some experiments, such as the HCX transport system at LBNL and the UMER ring at the University of Maryland, details of the beam distribution as it emerges from the source region can determine the beam behavior well downstream. This occurs because collective space-charge modes excited as the beam is born remain undamped for many focusing periods. Traditional studies of the source region in particle beam systems have emphasized the behavior of averaged beam characteristics, such as total current, rms beam size, or emittance, rather than the details of the full beam distribution function that are necessary to predict the excitation of the collective modes. Simulations of the beam in the source region and comparisons to experimental measurements are presented to illustrate some of the complexity in beam characteristics that has been uncovered as increased attention has been devoted to developing a detailed understanding of the source region. Also discussed are methods of using the simulation to infer characteristics of the beam distribution that can be difficult to measure directly.

